Transactions of the British Society for the History of Pharmacy

Jane O'Hara-May

Foods or Medicines ?

A study in the relationship between foodstuffs and materia medica from the sixteenth to the nineteenth century.

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FOODS OR MEDICINES ?

A study in the relationship between foodstuffs and materia medica from the sixteenth to the nineteenth century.

*by Jane O'Hara-May**

The present division between the disciplines of nutrition and pharmacology is underlined by the fact that the current Food and Drugs Act (1955)[1] is of little interest to pharmacists when compared with the Pharmacy and Medicines Acts. Yet the familiar way in which the words food and drugs go together echoes the close connexion there was between them in the past. A detailed study of the changing relationship between foodstuffs and materia medica has still to be written. This paper attempts to illustrate some of the changes in their relationship considered from a nutritional point of view, i.e. by examining alterations in the criteria used for assessing the functions and value of foods in the regimen for the preservation of health. To do this three examples, in the English language, have been chosen for consideration as being representative of their different periods.

The first example refers to advice given by writers on health in the late sixteenth century. Here the main source is *The Haven of Health* (London, 1589) by Thomas Cogan (1545 ?—1607) of Manchester.[2] Second the work of William Cullen (1712—1790) foremost teacher of pharmacy and medicine in eighteenth century Britain, with particular reference to his *Treatise of the Materia Medica* (Edinburgh, 1789).[3] The *Treatise* is selected as a fulcrum because Cullen's time and talents put him in the position of being able to look back at the remnants of the Galenic system and forward towards the new ideas of chemical analysis though he rejected these in the form he knew them saying, "I judge it [the chemical analysis of substances] to be of no use in explaining or ascertaining the virtues of medicines".[4] The final example refers to the work of Jonathan Pereira (1804—1853), particularly his *A Treatise on Food and Diet* (London, 1843) and to the editions of his *Elements of Materia Medica* (first edition, London 1839/40).[5] These are taken as being representative of ideas, in England, at the beginning of the development of modern nutritional concepts.

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*J. O'Hara-May, B.SC., M.A., PH.D., S.R.D., Sub-Department of the History of Medicine, University College, London, W.C.1. This paper is based on a lecture given to the British Society for the History of Pharmacy, in London, 1969.

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In considering these examples, from the point of view of ideas about the value and function of foods and drinks, the emphasis has, in general, been put on the following aspects of the material : (*a*) the contemporary views of digestion and metabolism, (*b*) the basis used for the grouping of foodstuffs, (*c*) the sources of information on foods, (*d*) the factors on which an assessment of the value, to man, of different foods was made, and (*e*) the relationship of food and drink to materia medica as illustrated by the regimen for health.

The terms food (and the earlier word "meate") and drugs are both ambiguous. Foods can refer to dry foods only or include both food and drink, therefore the word aliment, which embraces both food and drink, will be used where appropriate.[6] The Oxford English Dictionary gives the old meaning of drugs as "all ingredients used in chemistry, pharmacy, dyeing and all the arts generally". Through the centuries the meaning has become more specific but the use of the word today is still imprecise, therefore, in this paper, the terms medicaments or medicines will be used.

The basic distinction between aliments and medicaments has traditionally been that aliments provide substances which nourish the body whereas medicines are capable of changing the state of the body. This differentiation has never been a precise one. Cogan writing, in the late sixteenth century, on the diet to preserve health said,

> "And nowe shall I speake of herbs and fruits I mean of those that appertaine to diet as they be used for meate and not for medicine. For that belongeth to another part of physicke, though I know that there may be as Hippocrates sayeth *medicinable meate*".[7]

Just how close aliments and medicaments were in ancient times is emphasised by the teachings of the Hippocratic School (5th century B.C.) which said in *Ancient Medicine* that medicine had developed from a study of diet.[8] J. Stannard, commenting on Hippocratic pharmacology, points out that ". . . the viewpoint of the dietician is never wholly absent in Hippocratic discussions of simples".[9]

Today similar difficulties of differentiation remain. Paul Greengard in the section on vitamins in *The Pharmacological Basis of Therapeutics* (New York, 1967) explains that a healthy individual taking a well balanced diet will receive adequate amounts of vitamins from his food and that "vitamins "vitamins obtained in this normal manner can scarcely be regarded as drugs". Yet, he goes on to say when vitamins are employed in a chemically pure form they must be regarded as drugs.[10] Both these examples show that the division is often a pragmatic one, for the classification of a substance as an aliment or medicament may depend on the reasons for giving it and the conditions which obtain when it is given, rather than the individual characteristics of the substance itself.

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Sixteenth century ideas about food and drink

In sixteenth century England theories of physic were derived from the ancient teachings of Hippocrates, Aristotle and Galen with additional influences from later Arab and Christian writers. The Elizabethans accepted the humoral doctrine and believed that everything contained the four Aristotelian elements of fire, air, water and earth. In these elements were embodied the four qualities of hot, cold, moist and dry. An element was an essential vehicle for a quality which could not exist alone.[11] Everything contained a proportion of each element, and therefore of each quality, but was characterized by the predominance of certain qualities. The link between elements, their qualities and the body was through four body fluids or humours (blood, phlegm, yellow bile and black bile).[12] All four humours were present in each individual, but always one humour was dominant giving the person his characteristic complexion. The complexions were described as Sanguine (blood), hot and moist ; Phlegmatic (phlegm), cold and moist ; Choleric (yellow bile), hot and dry ; or Melancholic (black bile) cold and dry, and could be identified from clearly recognisable physical and psychological characteristics in the individual.

It was the balance of the humours that mattered. Health was the result of a proper balance of the qualities in the body of an individual, a balance appropriate to his natural complexion and circumstances which included age, activities and habits. Ill-health was the result of an improper mixture of the qualities. To achieve the correct balance consideration had to be given to all materials entering the body and to all body-losses.

The sixteenth century physician employed three tools to maintain or restore health. These were Diet, Medicine and Surgery. The most important of the three was Diet, which referred to the regimen or whole way of life of the individual.[13] Health was considered within the framework of : *things natural* that is seven innate factors in the body, namely : elements, humours, complexions, members [parts], powers, operations and spirits ; *things non-natural* Thomas Elyot (1541) gives the non-naturals as, air ; meats and drinks ; sleep and watch ; moving and rest ; emptiness and repletion and affections of the mind.[14] Cogan confines his list to five factors, i.e. labour, meat, drink, sleep and Venus, saying that this is easier to remember and follows the example of Hippocrates[15] ; *things against nature*, these are the cause of sickness, the illness itself and the aftermath. The importance of the non-naturals has been shown by L. J. Rather in ' The "Six Things Non-Natural" : A note on the origins and fate of a doctrine and a phrase '. Of these six things the greatest emphasis was placed on food and drink.[16]

Foods were grouped under general headings according to type. This was unrelated to any nutritional characteristics. Henry Buttes in *Dyets Dry Dinner* (London, 1599) gives this sequence for his foods : (*a*) Fruits ;

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(*b*) Herbs (originally the word herb could be applied to all plants, excluding only shrubs and trees, and therefore included what are now called vegetables) ; (*c*) Flesh ; (*d*) Fish ; (*e*) White Meats (dairy produce) ; (*f*) Spices (including sugar, honey and salt) ; (*g*) Sauces (including vinegar and mustard) ; (*h*) Tobacco (at that time tobacco was said to be ' drunk ' rather than smoked). Other authors omit tobacco but include the seven main drinks. These are water, wine, ale, beer, cider, metheglyn (made from honey and herbs) and whey. Water was, according to Andrew Boorde (1542) considered to be "unwholesome taken by itself, for Englishmen".[17]

Buttes gave a light-hearted explanation for this sequence of foods. Fruits were considered first because Adam and Eve fed on them in the Garden of Eden. After their exile they "fell to herbs and roots", then man turned to flesh and later to fish (as being the next easiest thing to catch). As the art of man's invention improved he obtained white meats. Spices and sauces were included later to suit the palate's demand for variety. This explanation is not as fanciful as it might appear. Writers on diet referred frequently to the authority of the Old Testament and had constantly to try and reconcile Galen's advice with teachings from the Bible. The greatest difference arose in relation to fruits. These were clearly the first foods appointed by God for man in the Garden of Eden yet Galen had not encouraged their use in his extensive advice on foodstuffs in *De alimentarum facultatibus* and *De probis pravisque alimentorum succis*.[18]

This change of attitude was explained, in the sixteenth century, as being due to the alterations that had occurred in man's body since his beginning, so that,

> "now all herbes and fruites generally are noyfull to man and doe engender ill humors, and be oft times the cause of putrified Fevers, if they be much and continually eaten".[19]

The emphasis here is really on the harm that could result from taking too much. A general (and more practical) attitude is reflected by Andrew Boorde when, considering God's works on earth, he said, "There is no herbe nor weede but God have given vertue to them to help man".[20] In fact, plant materials were then the main basis of materia medica. Stannard has shown the reliance placed on the *De materia medica* of Dioscorides (also called the Herbal of Dioscorides) until the early years of the Renaissance.[21] Charles Alston (1683—1760) counted about seven hundred plants, one hundred and sixty-eight animal substances and ninety minerals in Dioscorides "without reckoning the different simples the same species often affords".[22] Included in this list are such things as wheat, milk, eggs and flesh which, by common consent, could be classed as aliments as well as materia medica.

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In his paper, ' The Herbal as a medical document ', Stannard, referring to chapters on plants says that they, "tend to follow a pattern : the plant's name or names and its description, the complaints for which it is useful, how it is compounded, the method of administration and dosage, dietetic hints, and sometimes tests for fraudulent preparation".[23] These ' dietetic hints ' are elaborated in works on the dietary or regimen for health. Cogan takes ninety pages to advise on one hundred and twenty-seven vegetable foods and devotes a further seventy-five pages to all other foods. He does not include minerals in his *Haven of Health.* J. Theodorides and M. D. Grmek have recently written on the use of animal substances in materia medica of the sixteenth century.[24] They emphasize the use of the parts of animals rather than the flesh. Cogan devoted most of his advice to the flesh of animals but gave a short section on what he calls, ". . . the partes and members of such beastes as be usually eaten in England". Here Cogan rejected the dectrine of similars saying,

> "Some say that everie parte doth best nourish his like. Which if it were true, then should the head of a calfe or a sheepe best nourish the head of a man. But I thinke otherwise, for I know that the flesh of heades is very hurtfull to them that have the falling sicknesse, which is a disease of the head".[25]

For the basis of his advice on the value of foodstuffs Cogan, like his contemporaries, relied mainly on Dioscorides, with references to Galen's *De alimentorum facultatibus* and *De simplicium medicamentorum temperamentis et facultatibus* and quoted the *Pantegni* of Isaac Judaeus about the parts of beasts.[26]

The value of a food was considered under six general headings : Quality, Substance, Quantity, Time, Order and Custom. The last four headings refer to the relationship of the food to the individual eating it and the circumstances under which it is taken. Only quality and substance are related to specific characteristics of individual foods.

Quality : Foods were described according to the degree of their dominant qualities (hot or cold ; moist or dry). Each quality could be present in one of four degrees, and each degree could be graduated as at the beginning, middle or the end. Examples are : *Pheasant,* temperate in all qualities. *Sorrell,* cold in the first degree and moist in the beginning of the second. *Pepper,* hot and dry in the third degree, almost at the beginning of the fourth.[27] The qualities of foods could be influenced by cooking methods ; boiling could increase moistness and baking reduce it. This aspect had been considered in Hippocratic teachings ; *Regimen II* refers to the powers of various foods and the effects of cooking on these powers.[28] Similarly, in the sixteenth century Boorde (1542) considers the effects cooking could have on foods and says,

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> "For a good coke is halfe a physycyon. For the chefe physicke (the counceyll of a physycyon excepte) dothe come from the kytchyn : wherfore the physycyon and the coke for sycke men must consult togyther for the preparacion of meate for sycke men".[29]

The smell and taste of a food had also to be considered. Pleasant smells were believed to have a physiological as well as a psychological effect.[30] Tastes were linked to the qualities of hot or cold ; sweet, salt, bitter and sharp tastes had hot qualities.[31]

Other generalized characteristics of foods (sometimes also called qualities) were all related to maintaining the balance of humours, the avoidance of unnatural humours and any excessive retention or loss of body fluids. These can best be summarized by their effects which were described as ; costive or laxative ; causing oppilations (obstructions), putrefaction or flatulence ; being a diuretic, sudorific or aphrodisiac or containing an excess of superfluities which would cause unnatural humours. Lists are also given of foods which would engender choler, phlegm or melancholy or would affect various parts of the body. Advice on the last point is given in imprecise terms. An example from Elyot is :

> "*Meates* [*Foods*] *whiche do hurt the tethe*
>
> Very hotte meates, Bitter meates
> Nuttes, Leekes
> Swete metes and drinkes Fyshe fatte
> Radyshe roots Lymons
> Mylke *Colewortes*".[32]

Obviously practical factors, such as hard or hot foods affecting the teeth, were an important consideration.

Excepting any harmful characteristics, all the qualities used to describe foods are the same as those for which medicines were valued. In relation to their ' elemental ' qualities the same material could be considered as an aliment or medicament (in terms of the agreed definition of maintenance or change) according to the circumstances under which it was taken. Hot, moist foods, for example, were advocated in the diet of the young and of the old. The young, being naturally hot and moist, needed this sort of food to maintain their condition. The cooling and drying processes of ageing required that the old should have hot, moist materials to alter their state by combatting the natural change.[33]

Substance : Substance is not clearly defined by sixteenth century writers. It is probable that, in this context, it had the meaning of ' stuff ' with overtones of such things as bulk and texture. The substance of a food did effect its nutritive value, mostly in the process of concoction. Nutrition worked through the faculties of concoction, attraction, retention and expulsion and together with Generation and Auction [growth in length

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and breadth] was generally believed to be governed by the Natural Power. This power was linked with the Natural Spirit. Galen had doubted that there was a Natural Spirit, but many sixteenth century English physicians accepted the Vital, Animal and Natural spirits and their powers unquestioningly.[34]

The concoction of food took place in, broadly, three stages. The first concoction, in the stomach, was effected by heat and changed food into ' juice '.[35] The second concoction in the liver converted juice into blood. A third concoction in the parts altered the nourishing blood into the appropriate material. It was recognised that blood could be converted into flesh comparatively easily but the conversion of blood into bone went through a number of stages ; first the blood thickening into flesh and then the flesh hardening and whitening into bone. For this process, says Langton, "it muste both have a long tyme, and moche alteration".[36] The view that the concoction of aliments provided ' juice ' which could be taken into the blood and, in turn, be converted to the appropriate materials as needed, meant that no particular type of food was recommended for the nourishment of any particular part of the body.

Foods were judged according to whether they were easy or hard to digest and whether they made good or bad juice. On the whole, foods easy to digest and making good juice were described as ' fine '. These included bread made from "pure flour somewhat leavened, well baked not too old or too stale", new milk and young flesh.[37] ' Gross ' foods, like old flesh and unripe fruit, were hard to digest and made gross juice. However, the ease with which a food was digested depended on the power of the body into which it was taken as well as upon the characteristics of the food. If the body's power was such that it could concoct gross foods properly then gross foods were more nourishing than fine foods, because gross foods "maketh the flesh more firme and the official members [parts] more stronge thanne fyne meates".[38] Advice about the nutritive value of foodstuffs is hedged about with qualifications according to variations in circumstances. It is only in relation to materials that do *not* nourish that an unequivocable statement is found. Jean Fernal (1497—1558) in *De abditis rerum causis* (Paris, 1560), here quoted by John Jones (1572), says, "Nothinge can nourish us, which is not itselfe nourished and endued with lyfe . . ."[39] According to this concept the minerals in the materia medica could never be classed as foods. Otherwise the definition between aliments and medicaments is blurred and in practice books like Thomas Newton's *Approved Medicines and Cordiall Receiptes* (London, 1580) include descriptions of bread, milk, sugar, lettuce and oil, while many medicinal attributes are given to foods in books on diet.

This overlap of aliments and medicaments was inevitable in the context of sixteenth century thought because (i) The common derivation and close relationship of the subjects of diet and medicine within the frame-

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work of physick, (ii) The use of common sources of information, obtained from ancient teachings, about foods and medicines, (iii) The acceptance of the humoral doctrine under which the intrinsic characteristics of a substance were less important than the varying overall effects the material had on the body under different circumstances, so that at one time the substance could be used as an aliment and at another time as a medicament.

Changes in ideas of nutrition between Cogan and Cullen.[40]

The wide gap in time and thought between Thomas Cogan and William Cullen is here bridged by brief reference to the gradual, but fundamental, changes in ideas related to theories of diet. Basically the change was a rejection of Galenic ideas and the introduction of a more ' chemical ' approach to the study of foods and medicines.

Though Harvey's description of the circulation in *De motu cordis* (Frankfurt, 1628), was not immediately accepted into the teaching syllabus of medical schools, William Cullen, writing in the next century, believed that it was the general knowledge about, and acceptance of, the circulation, together with the discovery of the *receptaculum chyli* and the thoracic duct by Aselli and Pecquet, which "finally exploded" Galenic ideas, in about the middle of the seventeenth century.[41]

Another attack on the Galenic system came from the ideas of Paracelsus (1493—1541). Paracelsians believed that chemistry could form both a basis for understanding the macrocosm as a whole and be a key to the comprehension of the human body. A. G. Debus has shown that the full impact of Paracelsian ideas was felt in England in the seventeenth century though in the early years of the century he says, "the most common tendency was for physicians to rely on both the Galenic corpus and the more recent "Gesnerian—Paracelsian" corpus for the most useful remedies in each".[42]

The Paracelsian idea that digestion was effected by the *archaeus* of the stomach was not a serious challenge to the Galenic ' thermal ' theory of digestion. The real challenge came from the ideas of J. B. van Helmont (1577—1644) who substituted the action of ferments for the action of heat.[43]

The iatro-chemist's belief in the efficacy of metals led such anti-Paracelsians as James Hart to write scornfully in *KAINIKH or the Diet of the Diseased* (London, 1633) of the Paracelsian theory that metals nourish the body. (This would not have been acceptable to Hart because metals had not been endued with life).[44] Another point of conflict was the place that diet should play in the treatment of disease. Hart extended its use and the whole of the second book in *KAINIKH* deals with diet for the diseased.[45] Van Helmont, on the other hand, under the chapter "A Reason or Consideration of Food or Diet", says "Curing is not subject to the dietary

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part of medicine". He believed "that cures were the Effects of Medicines, but not of meats :".[46]

The compromise, generally accepted in the early part of the next century, was that diet could be useful in the treatment of chronic diseases. George Cheyne, author of *An Essay of Health and Long Life* (London, 1724) and an advocate of the use of vegetables, believed that many chronic diseases were due to ' Repletion ' and would be alleviated by ' Abstinence.' John Quincy, author of *Pharmacopoeia Officinalis and Extemporanea* (London, 1718) said,

> "In all Chronic Cases medicines are to be contrived as near to a Diet as can be ; and therefore the common Drinks and Foods are to be medicated as far as they will admit and the Case requires . . . But in acute cases, which are generally dangerous, there is required no such regard".[47]

Quincy's book was based on the official work the *Pharmacopoeia Londinensis* first published by the London College of Physicians in 1618. When Quincy's work was published the *Pharmacopoeia* had passed through three editions. A fourth was published in 1721. Another work based on the official formularly was William Salmon's *Pharmocopoeia Londinensis or the New London Dispensatory* first published in London in 1676.[48] It had been, the author says, "translated into English for the Publick Good and fitted to the whole Art of Healing". Though not approved by all (John Quincy described Salmon's collections as "being as bad as they are voluminous",[49] the work had gone to eight editions by 1716. A comparison of this with Quincy's work shows different approaches to classification. Both works included ' Galenic ' and ' chymical ' items, both claimed to follow an official line, though Quincy's work contained more extemporaneous additions and showed an attempt at simplification with a tendency toward ' kitchen physick '.

Two examples of aliments included in both books are :

(i) *Milk*[50]

Salmon explained that milk is refined blood and places it under ' Parts of animals '. The medicinal properties include : alleviating the swelling of the joints, "helps them that have the stone, and preserves from it", is good for ' dysentaries ' diahrhoes, asthmer, consumption, the eyes and headaches. Milk was recognised as the most nourishing food, easily digested. Quincy put milk under the main heading of ' Balsamicks ' and the sub-class ' Detergents '. He said "all that is done in the *Primae Viae* to our common Food, is but reducing it into *chyle*, which is *milk* . . ." As well as emphasis on nourishing properties of milk it was described as a ' restorative ' and advocated in consumption.

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(i) *Sugar* (from the sugar cane)[51]

Salmon classed sugar under ' gums '. He said that the white variety was best, then the gray, then the red. It was restorative and good for all diseases of the lungs. It could be used to reduce cuts and ease pain. No particular mention was made of its nutritive value. Quincy placed sugar under "Simples omitted, or not reducible under the former Heads". This section also included such foods as butter and bread. The medical effects of sugar were said to vary according to its fineness. The brownest was said to be sweetest and most suitable in purgatives. Common sugars were gross and viscid and might produce "many scorbutick symptoms". Honey, on the other hand, had, by tradition, many beneficial virtues. Sugar was referred to again under "Of Syrups, Confections, and Honeys" but seems to have been chosen mainly for the keeping qualities it imparted to the mixtures.

Quincy's "Extemporaneous Compositions" included twenty pages of "Diet Drinks, etc."[52] These drinks were based on wines, ales, meads and wheys and were intended to be taken regularly by chronic cases. The frequent references to diet-drinks in plays and the literature of the time indicate that they were commonly used as home medicines.

Besides his efforts to classify and simplify materia medica Quincy, differed from Salmon, in his more rational approach to medicine. The use of "The skull of man" in medicine is an example. Salmon said it is "a specific in the cure of most Diseases of the Head, but chiefly the Falling-sickness . . . The Triangular Bone in the Temples is the most specificall against Epilepsy". Quincy dismissed the subject saying : "It is to be feared that this [the skull of man] has obtain'd a Place in Medicine, more from a Whimsical Philosophy than any other account ;".[53]

Turning from pharmacopoeias to information given specifically on foodstuffs, the *Traité des Aliments* (Paris, 1702) of Louis Lémery is an example. Louis was the son of Nicholas Lémery author of *Cours de chimie* (Paris, 1675). The *Traité* received the approbation of the authorities in the University and the Royal Academy of Science in Paris. Translated as *A Treatise of all sorts of Foods* (1704), the English version was approved by the Royal College of Physicians.[54] The title page describes the work as giving an account of how to choose the best sorts of animal and vegetable foods and ' drinkables ' and "of the good and bad Effects they produce ; the Principles they abound with ; the Time, Age and Constitution they are adapted to". The "Whole divided into one hundred seventy-six chapters" ; in fact there are one hundred and ninety-six.

All foods were said to consist of the four principles, oil, salt, earth and water. Differences in action were due to differences in the proportion of principles contained in the foods. Lemery separated foods into the simple and the medicinal. In simple foods the principles were in the "proper

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proportion" ; simple food, it was said, "nourishes and restores the Parts, and keeps them up in the same State, as Bread does".[55] It was recognised that bread varied according to the materials used, the proportions, the preparation and method of baking. Bread made from wheat flour, with a little bran remaining, was considered best. Bread only caused ill effects if too much was eaten or it was badly made, otherwise it was described as nourishing and a good food agreeing at all times with "any Age and Kind of Constitution". It was said to contain "much volatile Salt, Oil and Phlegm [water]".[56]

Alternatively a medicinal food was said to nourish but at the same time it "alters the present and actual Disposition of our Body, as Lettice does".[57] Lémery differentiates between two sorts of lettuce, "the one they call wild *Lettice*, and is us'd only in Physic ; the other is Garden *Lettice*, which last is subdivided into several other Species,". Lettuces were said to contain much essential salt and phlegm, an indifferent quantity of oil and a little earth. In general terms "they are of a moistening cooling Nature ; they allay the over-violent Agitation of the Humours, loosen the Body, increase Nurses Milk, make People sleepy, and give good Nourishment".[58] The reader is warned against taking too much lettuce.

Aliments were grouped under the three general headings of "Foods made of vegetables, or Plants" (Sugar is placed, together with salt, at the end of this section. Lémery commented that common salt is the only mineral he knows of which is used in food) ; "Foods prepared of Animals" included milk under this heading. The third group ' Drinkables ' started with water and included chocolate, coffee and tea at the end of the section. A wide range of information was given on each subject because Lémery stressed that physicians ought to know about aliments so that they may prescribe foodstuffs correctly "according to the particular Ailment of each person".[59]

The introductory theory in the *Treatise of Foods* shows a mixture of Galenic, Cartesian and chymical idea. This was characteristic at the turn of the seventeenth and the beginning of the eighteenth centuries. Lester H. King has illustrated this in "Medicine in 1695 ; Freiderich Hoffmann's *Fundamenta Medicinae*", where he has summarized the chief schools of metaphysical explanation at the end of the seventeenth century. Included are Galenic (derived from Aristotle), Neoplatonic, Spagyric, Helmontian and the two Atomist philosophies of Descartes and Gassendi. King shows that, though influenced by all these approaches, "Yet in his specific discussions of physiological and pathological features, Hoffmann adhered to a Galenic schema, as modified by mechanical principles".[60] It was within this framework that Hoffmann set the ideas which were later developed by Cullen.

Between Cogan and Cullen, the decline in Galenic and rise of chemical ideas together with the trend towards systemization led to a reduction of

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the use of aliments in lists of materia medica. Also the place of the dietary approach in medicine shifted towards a use of diet in chronic cases only.

Aliments and Medicines in William Cullen's MATERIA MEDICA

William Cullen acknowledged a debt to Hoffmann for being the first to provide "in any tolerably simple and clear system" a theory which included the effects on the body, of the powerful influences of the nervous system and their application to disease,[61] but he said Hoffmann's fundamental doctrines were everywhere mixed up with humoral pathology. This was unacceptable to Cullen who described it "as incorrect and hypothetical as any other".[62]

A brief indication of a "few of the intellectual currents and crosscurrents of the mid-18th century" is provided by Lester S. King in the 1966 reprint of Albrecht von Haller's *First Lines of Physiology* ;[63] and reference to Cullen's ideas in the context of contemporary thought is made by T. S. Hall in his recent *Ideas of Life and Matter*.[64] Cullen developed his own, influential doctrine of neuro-pathology ; in his view the essential vital phenomenon was nervous excitation. Under the heading "the actions of medicines upon the body in general" he dealt with the following three main aspects, body solids, body fluids, nervous excitation or power.[65] Body solids were either ' simple ' or ' vital '. The vital body solids made up the nervous system. Cullen said that, because the nervous power appears only in the living and disappears at death it "may be otherwise properly enough termed the *vital principle*".[66] The internal condition of the body was estimated by a consideration of these related factors. 1. The state of the simple solids ; 2. The state of the fluids ; 3. The proportion of solids to fluids ; 4. The distribution of the fluids ; 5. The state of the nervous power.

In notes for a course on therapeutics, Cullen divided remedies into classes according to their action upon the simple solids, the fluids, the moving powers and extraneous matter lodged in the body. The substances which acted upon the simple solids were sub-divided according to their effect, that is, "as they serve to supply their matter, consume their matter, to strengthen their cohesion or weaken their cohesion, under the general titles of Nutrients, Corrosives, Astringents and Emollients [respectively]."[67]

Cullen's own definition of aliments and medicines states that aliments are "such substances as are suited to supply the matter, whether solid or fluid, of the human body". Medicines were said to have "no such property but one capable of variously changing the state of the body, and particularly of changing the state of disease into that of health".[68] They could not, therefore, be applied to the class of Nutrients but did fulfill the requirements of Corrosives, Astringents, and Emollients.[69]

Like other, contemporary, writers on materia medica Cullen was a

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systematizer, but he differed from the usual method in the presentation of his material. The usual practices, he explained, were to list items alphabetically or under botanical classifications. Cullen differed from this by making a complete separation of aliments and medicines. Volume I (pp. 217—432) of the *Materia Medica* is devoted to aliments ; medicines fill Volume II (pp. 1—590). In his chapter "of the most proper plan for a treatise of the materia medica" Cullen explained that his object was to "arrange the several substances according to their agreeing in some general virtues".[70] He acknowledged that there would be some overlap and that "alimentary matters may become subjects for materia medica" by a "certain management"[71] but he supports his separation on the basis of practical teaching effectiveness, saying,

> ". . . yet I maintain, contrary to the practice of writers on materia medica ; that such substances should be considered under the different views that may be taken of them as aliments or medicines ; and these should be considered separately, to avoid distracting the student by different views presented at the same time".[72]

Under the general heading of *Aliments*, Cullen made two main divisions of Meats and Drinks. Under meats were classed everything, whether solid or liquid, which might be considered alimentary, according to Cullen's definition given above. Drinks were those things which were "especially and almost only, fitted to give liquidity to the aliments, and supply the water necessary to the body".[73]

The general groupings were Vegetable, Animal, Drinks and Condiments. The last though "not properly alimentary" were included because they were taken with foodstuffs and affected their digestion and assimilation. Cullen also devoted a section to the effects of cooking. The changes produced in cooking were considered important in relation to ease of digestion of the food in the stomach. Each group of foods was further sub-divided ; space allows only an indication of their content.

VEGETABLE ALIMENTS

A. *Fruits.* These were given the heading "Fructus Acidodulces, or Summer Fruits" and included such different types as apples, plums, grapes, oranges and strawberries. Reference was made to fresh and preserved varieties also to the *Curcubitaceae.*

B. *Leaves and Stalks of Plants.* Cullen said "Of the leaves and stalks of plants used as aliments, I have set down only a few, as of these kinds of plants few afford much nutriment" ;[74] he referred to cabbages, lettuce, succory and endive with some detail.

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C. *Roots* "The roots of plants commonly contain more nutritious matter than their leaves ;"[75] Cullen continued by referring to the work of Parmentier on nourishing vegetables but said that he believed that the farinaceous matter extracted from roots was exactly the same from whatever root it came.[76] Included are radishes, turnips, carrots, parsnips and garlic. Potatoes are added to the list but discussed in detail under the seeds of plants because, "This root by a proper drying, is readily brought into a farinaceous powder that has every property of the Carelia, except that it affords no gluten or animal matter, as wheat does".[77]

D. *Seeds*

(*a*) Cereals and potatoes.

(*b*) Legumes ; these seeds were considered to be of an ' oily quality ' and, said Cullen, from the experiments of Robert Boyle and Stephen Hales appeared to "contain a large quantity of air in a fixed state,". Here Cullen meant any air that was held in the seed.[78]

(*c*) Oil seeds. Under this heading oily farinaceous seeds and expressed oil were discussed including hazel nuts, chocolate and olive oil.

E. *Fungi* Under *Esculent Fungi* Cullen explains he has not had sufficient experience of them to note different qualities in different varieties and comments, "If they are truly vegetable matters, which some have doubted of, they are truly different from every other vegetable that we are acquainted with :".[79]

ALIMENTS FROM THE ANIMAL KINGDOM

(i) *Milk* Cullen started this general section with milk, because, he said, it is, "commonly and justly held to be of an intermediate nature between entirely vegetable and entirely animal aliments".[80] Cullen rejected the idea that milk *was* chyle but speculated that part of milk may come from it.[81] In his Preface Cullen had commented that he had written at length "upon subjects the most important, and most frequently employed in practice ; such as Milk, Peruvian Bark, Opium, Camphire, Mercury, and several others".[82] He devoted fifty pages to milk and milk products in which he explains the value of milk as a food for

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infants and in the adult diet. Following this with a description of milk as a medicine, he advocated it for *phthis pulmonatis*, for gout (under certain circumstances) but did not prescribe it, as some others did, in cases of fever.[83]

(ii) *Mammalian quadrupeds* "The solid and fluid parts of the mammalia are so nearly of the same nature with one another that the fitness of all of them . . . for nourishing the human species, can hardly be doubted of, and is very well established by much experience".[84] Following this introduction Cullen dealt briefly with different animals used for meat.

(iii) *Birds* Included here were wild and domesticated birds and their eggs.

(iv) *Amphibia* Examples included were reptiles, serpents, "sea tottoises and frogs", most of which were not commonly used in Britain.

(v) *Fishes* Cullen specifically made no distinction between the value of fishes according to their habitat, as had traditionally been the custom.[85]

(vi) *Insects* Lobster and crab were included here.

(vii) *Worms* This section included oysters, cockles, mussels and snails.

The Cookery of Meats

The application of heat was considered to increase the ' solubility ' of the material cooked. Whether vegetable aliments required cooking was a matter for special consideration. "I do not recollect any species of vegetable substance that may not be taken in the raw state by men of tolerable health and vigour". But Cullen noted that man's instinct was directed to the cooking of vegetables and this implied "that in many cases it is proper, and attended with some advantages".[86] The advantages included increased solubility, loss of volatile parts and the removal of air present in the vegetable which retarded fermentation.

Drinks

Simple Water. Cullen said, "simple water, that is, such as nature affords it, is without any addition the proper drink of mankind".[87]

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Fermented liquors. This group was listed under "Drinks whose Basis is Water, but to which Additions have been made by Nature or Art". It was subdivided into those made from the juices of fruits (wines) and those from roots or seeds (ales). Wine and alcohol were referred to again under medicines ("sedentia").[88] Drinks made by the addition of materials to water are described under the appropriate heading (of aliment or medicine) for the material added.

Condiments. These were classed as saline or acrid [bitter]. Saline condiments were sea-salt, sugar and vinegar. A number of the acrid condiments were referred to again under medicines.

Whatever their origin, when taken into the blood, the nutritive parts of foods were formed into a single alimentary principle or ' animal mixt '. This supplied the material for the maintenance of all body solids and fluids. Cullen gave his ideas on the conversion and assimilation of aliments in his *Institutions of Medicine*.[89] Briefly, the change of foods into the animal mixt was started during digestion by the mechanical division of the solids, the application of heat (in this case "the common temperature of the human body") and by the action of a "proper menstruum". The menstruum referred to here is a compound of the liquids taken into the body, the saliva and gastric liquors. Cullen acknowledged that he did not understand exactly how this ' peculiar [special] solvent ' worked.[90] He referred his readers to Steven's *De Alimentorum Concoctione* (Edinburgh, 1777). After digestion the nutritive parts of aliments passed into the common mass of blood.

Blood consisted of three parts. (1) The red globules. (The function of the red globules was not understood by Cullen[91]). (ii) The gluten or coaguable lymph. Gluten is the modern name for wheat protein, the word originally had the meaning of ' gluey substances ' and referred to a number of materials apparently similar to coaguable lymph. (iii) The serosity. The serosity was formed of salts washed away from the gluten and the water present. The gluten or animal mixt was derived from the nutritive parts of aliments through "the peculiar powers of the animal oeconomy".[92]

Because the animal mixt had a tendency to putrify it did not remain static. Putrefaction caused the mild neutral substances present to be changed to saline salts "of an ammoniacal kind". It was these salts which, when washed away from the gluten formed the serosity. This was excreted in various forms to keep the proportions right in the system. The tendency of the animal mixt to putrefy could be inhibited or retarded by the provision of more aliments.

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In this doctrine the function of the aliments was to provide a suitable animal mixt for the maintenance of all the solids and fluids of the body. All nutritive parts went into the mixt and all the different parts of the body were derived from it without any specific nutritive parts being realted to specific structures. The value of foods depended upon the ease with which they formed gluten, emphasis being placed on their degree of solubility in the stomach. Animal foods were considered to be "so nearly of the same nature as the body itself that, . . . they seem to require no other change but that of being rendered fluid".[93]

Vegetable aliments were so obviously different that they had to be changed by "powers within the body itself". The possibility of such a change was acceptable in Cullen's time for two reasons. Firstly it was recognised that probably all animal matter was originally formed from vegetable meterial because, "all animals either feed directly and entirely on vegetables, or upon other animals that do so".[94] Secondly Iacopo Bartolomeo Beccari had discovered gluten in wheat and shown in 1728 that the chemical principle, hitherto, thought to be a component only of animal substances was, in fact, also present in vegetable matters.[95] Cullen discussed the conversion of vegetable material into the animal mixt and concluded that the alimentary principles present in vegetables were acid, sugar and oil. He was uncertain about the value of the mucilagenous parts of plants but considered that gum arabic ("the most simple and pure mucilage") was alimentary material because it was a compound of the three alimentary principles.[96] The nutritive value of these principles was judged on an imprecise basis. The acid of vegetables was considered to help acidify the stomach and to retard putrefaction in the animal mixt. Cullen stresses that, "it would appear that the alimentary quality of acid is confined to the native acid of vegetables, as it is produced in them by nature, or as it is evolved from acescent [sour] vegetables, or from sugar in the stomach".[97] The several Fossil acids were thought not to enter into the composition of the animal fluids, because they passed out of the body unchanged in the excretions, they irritated ulcers and did not cure scurvy.[98] They are shown under the section on medicines to be antiseptic and have diaphoretic, irritant and diuretic effects as they pass through the body.[99]

Cullen was uncertain what sugar was.[100] The estimation of its nutritive value was firmly based on the fact that it was part of the farinaceous substances and these, particularly wheat, had by observation been proved to be the most nourishing of the vegetable aliments.[101]

Oily seeds were recognised as being nutritious. Some believed that this was the only form in which oil could be taken to nourish the body. Cullen disagreed ; he believed that pure oil was a "fundamental part of human aliment". This view was based on his belief that, "Not only no chyle, but neither does any oil ever appear in any part of the mass of

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blood, nor ever in any part of the human body, till it appears in the cellular or adipose membranes . . .".[102] Cullen attributed any traces of oil seen in the blood to an abnormal condition.

In Cullen's discussions of these three principles there is a move toward the identification of particular alimentary principles and their related functions within the concept of aliments acting solely through the animal mixt. By contrast the function of medicines depended "upon their action upon its [the body's] sentient and irritable parts".[103]

To determine the value of medicines the following methods had been used ; chemical examination, botanical affinity, estimation of the sensible qualities and the results of experience. Cullen showed the difficulties and disadvantages of all these criteria. He himself favoured experience. Though the general movement was toward chemical analysis, Cullen omits this from his *Materia Medica.* He says it is, "an omission which, if I mistake not will require no apology in the present age".[104] Cullen was too near the end of his life to be able to visualize the significance of the new analytical methods, of Lavoisier and Berthollet, developed between 1780 and 1785. F. L. Holmes, in "Elementary Analysis and the Origins of Physiological Chemistry" calls this period the second stage of analytical development following the dry distillation methods.[105] The dry distillation methods are, of course, those with which Cullen would have been familiar.

The clear separation of aliments and medicines in Cullen's *Materia Medica* can be contrasted with a number of contemporary cookery books in which "Phisical receipts" were included with cookery recipes. Examples of this home-doctor advice can be found in Eliz. Price, *The New Book of Cookery or Every Woman a perfect Cook* (London, 1780) and Catherine Brooks', *The Complete English Cook : or Prudent Housewife* (1780).

> "To which is added, The Physical Directory ; Being near two Hundred safe and certain Receipts for the Cure of Most Disorders incident to the Human Body".

Various advice was given for a "Consumption". This ranged from

> "taking no Food but new Butter-milk churned in a Bottle and White Bread . . . Or, every Morning cut up a little Turf of fresh Earth, and, lying down breathe into the Hole for a Quarter of an Hour".

Mrs. Brooks adds, "I have known a deep Consumption cured thus".[106]

Probably the most famous cookery book of the period was Hannah Glasse's *The Art of Cookery made Plain and Easy* (first edition London, 1747, with new editions regularly into the nineteenth century). Here information was restricted to cooking and preserving including "Directions for the Sick" (i.e. food for invalids), "A certain Cure for the Bite of a Mad Dog" and a receipt against the plague.[107]

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Another change in the eighteenth century idea of dietary treatment came with the development of new types of ' voluntary ' hospitals in England. W. B. Rabenn in "Hospital Diets in Eighteenth Century England" referred to the introduction of specific diets to supplement the traditional hospital diet which was known, in different localities, as the general, full, common or ordinary diet. New types of diets included the middle or half diet and, Rabenn says, "Schedules for fever, milk, dry and salivating diets gradually appeared. They are representative of a trend toward the individualization of therapy in which physicians sought to treat signs and symptoms rather than particular diseases".[108] The inclusion of special diets for fever patients illustrates a change from the concept of special diets only for chronic cases, advocated earlier.

Through his systematization, nosology and neural-pathology, Cullen made a sharper distinction between aliments and medicines than his predecessors. This distinction was not based on composition (though reference was made to the alimentary principles of acid, sugar and oils) but rather on function ; the function of foods being to supply material for the animal mixt, while the function of medicines was to alter the condition of the body by acting upon the nervous system. Shortly after Cullen these ideas were superceded by the concept of function being related to the chemical composition of a material. It is in the separation of subject matter, that is, in a divergence between nutrition and pharmacology that Cullen's attitudes and influence must have had long term effects.

Early dietary theories based on physiological chemistry.

In *A History of Nutrition* (1967), E. V. McCollum pointed out that "food analysis—the quantitative determination of components of foods which were believed to have physiological importance—was for many years based in great measure upon a body of knowledge which has been accumulated by chemists whose interest was in medicinal drugs".[109] This still held true in the early part of the nineteenth century but began to change with the increased importance of chemistry in the fields of general physiology and agriculture. J. A. Paris in *Elements of Medical Chemistry* (1825) says, "But there are changes perpetually going on in the animal body that are beyond the control of the living principle and therefore the Physiologist who is not a chemist will be utterly at a loss to comprehend them".[110] Increased emphasis was put on the chemical components of foodstuffs, particularly in terms of their content of carbon, nitrogen, hydrogen and oxygen.

William Prout in his work "On the ultimate composition of simple alimentary substances" (1827) rejected the traditional Hippocratic idea of one alimentary principle. Basing his views on his analysis of milk (which he considered a perfect food) he reduced all "the principal

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alimentary matters employed by man" into three classes. These were the *saccharine*, the *oily* and the *albuminous*. Each of Prout's principles included a wide variety of foods. For example, the saccharine principle referred to the "whole family of substances in which hydrogen and oxygen are found in the same proportion as in water". Under this heading he discussed, various types of sugars ; amylaceous material ; lignin [cellulose] ; vinegar ; milk-sugar and vegetable acids. Prout considered the terms *saccharine principle* and *vegetable aliment* to be synonymous.[111] This grouping of foods, in relation to their chemical composition, was used as a starting point by a number of later workers.

In 1842 Justus von Liebig published his *Animal Chemistry* in which he grouped foods according to their chemical content and function.[112] Albuminous or nitrogenous foods were described as "plastic" and were considered to provide material for growth and movement. Liebig called non-nitrogenous (i.e. carbohydrates and fats[113]) foods "respiratory" and postulated that body temperature was maintained by their breakdown.

The theories of Prout and Liebig formed the foundation for Jonathan Pereira's advice on food and diet. A contemporary Charles A. Lee described Pereira as, "well known throughout Europe and America as one of the most learned, scientific and practical men of the age, . . . "[114] He was famous for both his *Elements of Materia Medica* (1839/40) and *A Treatise on Food and Diet* (1843).

The *Elements* went to three editions before Pereira's death and continued under a variety of editors until the last edition of 1874.[115] The first edition had the full title of, *The Elements of Materia Medica, comprehending the natural history, preparation, properties, composition, effects and uses of medicines.* It contained no section on the aliments. In the second edition the title was changed to *The Elements of Materia Medica and Therapeutics* and Pereira extended its scope by adding, "articles on Mental Impressions, Light, Heat, Cold, Electricity, Magnetism, Diet, Climate and Exercise, considered as Therapeutic Agents".[116] Under the heading "Agentia Hygienica—Hygienic Agents (Non-Naturals.)" Periera refers to the "absurd" name of the non-naturals under which the ancients included six things necessary for health ; viz. air, aliment, exercise, excretions, sleep and affections of the mind.[117] Pereira dealt with affections of the mind under "Psychical or mental remedies" and placed foods, climate and exercise under hygienic agents. He omitted excretions and sleep.

In the second edition the section on "Cibus-Food" covered thirty-four pages. The material was based primarily on Prout's classification and ideas and Tiedmann's separation of alimentary principals from compound aliments.[118] Included was information about the main groups of foods, with some tables of chemical analysis, and a section on the "Dietetical Regimen". Of this Pereira said, "In the treatment of many diseases, attention to diet is a point of considerable importance".[119] He referred to

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five types of diets available for the sick in London Hospitals, i.e. animal, vegetable, milk, low and full diets. Foods were also dealt with individually in the body of the text with references made to both their dietetical and medicinal uses.

The appearance of Liebig's *Animal Chemistry* necessitated a complete revision of this section on food.[120] In the 3rd edition of the *Elements* (1849/53),[121] Prout's ideas and classification were considered in relation to Liebig's theories. Here the section on Foods was reduced to five pages omitting all references to the dietetical regimen, though the descriptions of individual foods were still retained in the general text.

For Pereira, this change emphasised rather than diminished the importance of diet. He had intended, he said, to "treat the subject [food and diet] in the same full and systematic manner" that he had used for the articles in the materia medica.[122] But the subject was too large and Pereira had to content himself by producing his *Treatise on Food and Diet.* In this book, of 542 pages, Part I dealt with foodstuffs and Part II with the dietetic-regimen. The treatise differed from previous works of this sort, in that it contained "a tolerably full account of the chemical elements of food", an aspect which, Pereira said, "preceding dietetical writers have altogether passed over or only incidentally alluded to".[123] Pereira's classification of foods emphasizes the separation of alimentary principles and compound aliments in this way :

1. Chemical Elements[124]

   Of the fifty-five elements known at that time, nineteen had been found in "organized or living bodies". Thirteen of these were essential constituents of the human body and "the same, therefore, must be the elements of our food". Given in modern notation the thirteen elements are : C, H, O, N, P, S, Fe, Cl, Na, Ca, K, Mg, F. Pereira pointed out that traces of manganese had been detected in the blood but he has "not included this metal as an essential constituent of the hyman system".

   The recognition that the body needed these elements, and taht they were obtained from food, altered the concept of the nutritive value of metals and minerals.

2. Alimentary Principles or Simple Aliments[125]

   Pereira increased Prout's "four great classes or groups" to twelve. Here Pereira referred the reader to Prout's *On the Nature and Treatment of Stomach and Urinary Diseases* (London, 1840) in which Prout had added the ' aqueous ' group of foods to his three other classes.

   Pereira's alimentary principles were formed by the union of two or more of the "undecompounded bodies" described above.

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They were :

(*a*) Aqueous
(*b*) Mucilagenous or gummy
(*c*) Saccharine
(*d*) Amylacious
(*e*) Ligneous
(*f*) Pectinaceous
(*g*) Acidulous (vegetable acids)
(*h*) Alcoholic (alcohol was considered an "element of respiration", i.e. a fuel in the animal oeconomy)[126]
(*i*) Oily and fatty
(*j*) Proteinaceous (fibrine albumen, casein)
(*k*) Gelatinous
(*l*) Saline (common salt, earthy phosphates, potash salts, ferruginous compounds).

3. Compound Aliments

These consisted of two or more alimentary principles. The generally familiar division was used :

(i) *Solid aliments, or aliments proper*

Animal foods under the headings : mammals, birds, reptiles, fishes, crustaceans and molluscs, with a note on "diseased and decayed animal substances".[127]

Vegetable Foods, Class I, aliments from flowering plants, seven types are listed.

Class II, from flowerless plants, e.g. lichen, algae and fungi.

(ii) *Liquid aliments or drinks*

These are sub-divided into six groups :

farinaceous or saccharine ; aromatic or astringent ; acidulous ; broths and soups ; emulsive or milky ; alcoholic.

(iii) *Condiments or seasoning agents*

Pereira commented that most condiments are, in fact, alimentary substances, quoting Sugar, Oil or Fat and Vegetable Acids. He pointed out that "Common Salt, which by most dietetical writers is spoken of as if it were a mere luxury,—as if its use were to gratify the palate merely,—is essential to health and life, and is as much an aliment or food as either bread or flesh".[128]

The information given about all these classes of foods was both comprehensive and practical.

In the second part of the *Treatise* under Diet, Pereira proposed "to consider briefly the adaptation of aliment to the different wants and conditions of human existence".[129] He started by describing the digestibility and nutritious quality of food and then dealt with the "dietetical treatment of diseases".

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Assimilation, by which alimentary substances were converted into the organised tissues of the body, had two parts. *Primary assimilation* was the conversion of food into blood ; while in *secondary assimilation* "organized or living textures (sic) are formed from the blood, and afterwards re-dissolved and removed from the system".[130]

Digestion was an important part of primary assimilation and was considered, by Pereira, to be partly mechanical but "princially a chemical process". (Pereira had "offered some objections to the fermentation hypothesis".[131]) The digestibility of foods was an important factor in their value to the body. A rough comparison of natural digestibility of food-stuffs was provided by William Beaumont's tables "showing the Mean Time of Digestion of different articles of diet".[132] Pereira explained, "In digestion, as in all chemical processes, cohesion is a force which is opposed to molecular changes : and the efficacy of various means of augmenting the digestibility of foods is ascribed to their influence in lessening this force".[133] It was recognised that the digestibility of foods could be improved by cooking them.

In the secondary assimilation the formation of living material depended upon the value of the digested foods, that is upon the chemical elements in the alimentary principles they provided. Pereira accepted that the living body had no power of creating elementary substances and therefore the human system had to be supplied with foods containing all the elements of which it was composed. It was not sufficient to supply the elements in their "raw or uncombined state" ; for the animal system had not "the power of forming its organic constituents out of simple or elementary bodies".[134]

Though the body could effect "a considerable number of combinations and decompositions", its chemical powers were limited, Pereira says, "It [the living body] cannot form the organic constituents of tissues out of any substances which might happen to contain the same elements, but only out of those substances whose composition and properties are analagous to, or identical with, those of the principles of which the tissues are composed".[135]

Pereira could not accept Liebig's views "as to the exclusively nutritive quality of nitrogenized foods", and also objected to Boussingault's scale of nutritive equivalents based on the quantity of nitrogen found in foods, though he did acknowledge the importance of nitrogen in the formation of living tissue.[136] The value of non-nitrogenous foods probably lay, said Pereira, in the proportion of carbon they contained and "perhaps their ultimate use is to act as a fuel to be burnt in the lungs and thereby develop sufficient heat to support the high temperature necessary for the maintenance of vital power".[137] This emphasis on the chemical composition of foods provided individual foods with an intrinsic value, which gave a measure for comparison with other foods, but still the complete nutritive

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value of a food could only be judged in relation to the needs of the individual consuming it. Therefore all diet plans had to be adjusted to fit the condition of the person taking the food.

In his chapter "On Dietaries" Pereira insisted that "an accurate aquaintance with the quantity and quality of food necessary to the maintenance of human health and life, under different circumstances is a matter of interest to everyone ;".[138] This interest was considered,to be especially important for those who had the responsibility for caring for others. These people were listed as : statesmen, magistrates, naval and military officers, physicians and surgeons, governors of hospitals and other public institutions, and the guardians of the poor. Pareira believed that dietary theories should be applied for the benefit of the health and the sick and discussed the quantity and quality of foods needed by. different groups of people. He illustrated his advice with dietary-tables.

Dietaries For The Healthy

Children

Pereira followed the accepted belief that the natural appetite could be taken as "an index of the wants of the system".[139]

It was obvious that many children did not get enough foods for their needs for he comments on the many examples, to be seen all around, of the "ill consequences of defective nutriment" and the poor physique of pauper children.

Seven daily ration scales from "several of the principal metropolitan establishments for children" were given. These included : a foundling hospital, military and naval asylums, orphanages, "Mr. Aubin's Establishment at Norwood, Surrey" and children's hospitals in Paris.[140]

If the children fell sick their diet would be prescribed by the medical attendant. Pereira made no comment on the details of the dietaries.

Adults

(i) *Dietary for the Naval Service*

The tables given came from the *Regulations for His Majesty's Service at Sea* (Jan. 1st 1833) and provided about 43 oz of dry food and a gallon of fluids per man per day on a fresh meat ration. The salt meat ration was slightly lower. After fourteen days on salt foods an additional allowance of lemon juice with sugar was to be issued as an anti-scorbutic.

Pereira believed that the allowances of food supplied "were most ample though not excessive". He questioned the scale of equivalents used for the substitution of one food for another, 8 ounces of fresh vegetables being given as equal to 12 ounces of flour. According to his calculations and Boussingault's nitrogen scale the equivalent should be in the order of 86 ounces of fresh vegetables to 12 ounces of flour.

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Subjoined to these scales were the scales for : "Victualling for Troops from England to India" as fixed by the East India Company, and the "Dietary for Emigrants" as fixed by Her Majesty's Colonial Land Emigration Commissioners.

(ii) *Army Rations*

Soldiers, in Great Britain, paid for their rations. About 196 ounces of solid food per week, i.e. 1 lb. bread and $\frac{3}{4}$ lb. meat per day were provided for a daily cost of 6d. whatever the market price. The soldier furnished other provisions for himself.

(iii) *Dietary for Able-bodied Paupers*

The Poor Law Commissioners had adopted six dietaries for use in Poor Law Institutions. The Board of Guardians selected the diet most suitable for the circumstances of each Union. Pereira provided a table of cooking losses of meat observed in "pauper establishments". This amounted to an average of thirty per cent by weight. Comment was also made on the proper method of serving the food to avoid loss.[141]

(iv) *Dietaries for Prisoners*

In January 1843 the Inspectors of Prisons had reported to Her Majesty's Secretary of State regarding the system of Prison discipline. The Report included recommendations regarding the diet for various classes of prisoners. Pereira approved of these recommendations and gave basic dietary recommendations and diet tables from the Report. The principle laid down by the Inspectors was that "the quantity of food supplied to prisoners should in all cases be sufficient, and not more than sufficient, to maintain health and strength".[142] Pereira, like others before and after him, had to argue against those who believed that the diet of a confined person, whether prisoner or pauper, should not be better than "a sober and honest labourer can in general obtain for himself and his family ;" But Pereira said, "the question is, not what the honest labourer can obtain, but what is necessary for the prisoner ; and, under this point of view it appears to me that there exists no just ground of objection to these rates of diets".[143]

Ration scales of sorts had been in use for centuries but the type of detailed discussion presented by Pereira was the outcome of a greater awareness of the effects of poor diets, and an increased sense of public responsibility arising from a change in social attitudes. The Poor Law Amendment Act of 1834, the Prison Act of 1835, the statistical reports on the health of the Navy and Army in the 1830's all contributed information, and new attitudes, towards the importance of diet in the maintenance of health and strength among different groups of the population.

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DIETARIES FOR THE SICK

In his introduction to this section, Pereira pointed out that attention to diet was of considerable importance in the treatment of many diseases. He stressed particularly non-febrile disorders of the digestive and urinary systems. Diet was not so significant in acute illness where a low diet would be a recommended because the patient would himself have no appetite for food. Dietetic treatment was more important in chronic diseases, especially where the normal appetite was unimpaired and too much food might be taken. However in chronic local diseases, where the appetite was good, a normal diet was preferable to a low diet.

Pereira provided a brief discussion of eight main diets and gave examples of them from the diet tables of twelve major hospitals.[144]

1. *Full, Common or Meat Diet,* was recommended, on the many occasions, when it was desirable to "restore or support the powers of the system". The diet contained a mixture of animal and vegetable foods.

2. *Animal Diet.* This term was applied to a diet which was either exclusively or principally composed of animal foods. The only disease in which a diet of exclusively animal foods was prescribed was diabetes. This followed the recommendations of J. Rollo made in 1797.[145] Vegetable foods were not only considered harmful to the diabetic but were also thought to be a causative factor of the disease. According to George Budd, in 1842, "A prominent place among the causes of diabetes has also been assigned to prolonged errors of diet, and especially to the prolonged use of a diet too exclusively vegetable".[146] However many doctors preferred to recommend diabetic diets which contained some vegetable foods and the value of Bouchardat's gluten bread for diabetics was mentioned.[147]

3. *Vegetable Diet.* A diet of distilled water and only vegetable foods had been advocated by a Dr. Lambe for conditions of cancer, scrofula, consumption, asthma and other chronic diseases. Pereira dismissed the diet with the remark that Lambe "has, I suspect, gained few, if any, proselytes to his opinions and practice".[148]

4. *Spare or Abstemious Diet.* The object of this diet was to diminish the amount of nutritive matter supplied to the system while keeping the digestive organs actively employed. Generally the diet consisted mainly of vegetable foods but white fish could also be included. Because this flesh contained a higher proportion of water it was considered to be less stimulating than butchers meat.[149]

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5. *Fever Diet*, also described as, Thin Diet, Spoon Diet or Slops. Pereira quotes William Beaumont as saying, "In febrile diathesis, very little or no gastric juice is secreted. Hence the importance of with-holding food from the stomach in febrile complaints. It can afford no nourishment, but is actually a source of irritation to that organ ; and consequently, to the whole system".[150] Therefore foods which "required digestion" were to be withheld. Drinks and some saccharine or amylaceous materials were recommended usually in the form of gruel, bread and milky drinks.

6. *Low Diet.* Similar to the fever diet, this was advocated in cases of acute inflammation of "important organs" after serious accidents, surgical operations and parturition. The diet affected the blood and "was similar to that of a loss of blood ; namely a diminution of the number of blood disks". Here Pereira referred his readers to Andral and Gavarrat's "Récherches sur les Modifications de Proportion de quelques Principes du Sang" (1842).[151]

7. *Milk Diet.* This supported the system with the minimum stimulation and should be given in cases of inflammation of the chest, the alimentary canal or bladder and after haemorrhages. The basis was cow's milk with additional starchy materials such as arrowroot or bread and light puddings. The diet was also recommended as a "preservative" against gout and in a number of children's diseases.

8. *Dry Diet* was a restricted fluid diet in which a variety of solid foods could be used. The object was to help reduce the volume of the blood in cases of valvular heart disease, aortic aneurism, diabetes and diuresis.[152]

In his comments on diet tables from London Hospitals Pereira once again had to argue against the view put by W. B. Carpenter, that, "As a whole, the diet of patients in English hospitals is much too high, being far better than that to which the same class of person is accustomed to in health : this is attended with injury to the patients, and with increased expense to the institution ".[153]

The type of diet to which Carpenter referred was of this sort. The example is from Guy's Hospital.

Full Diet
14 oz. Bread.
1½ oz. Butter.
1 quart Table Beer.
8 oz. Meat when dressed.
Gruel or Barley-water to be given as required.

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While he agreed with Carpenter that the diet might be better than the patient was accustomed to, Pereira insisted that it was not "much too high". Recognising that no diet scale will be suitable for every individual case, he contended that, as a whole, the dietaries of metropolitan hospitals were "unexceptional".

Dietaries For The Insane

The diet tables from Hanwell Asylum, Bethlem and St. Lukes's hospitals show the diet to be similar to the full diet of a general hospital. But according to Dr. Connolly, of Hanwell, in all lunatic asylums some patients required much more food than others and the capriciousness of patients in their demands for food had to be dealt with by "temporary indulgence and little allowances". Otherwise, said Conolly, "a great amount of discontent will occasionally prevail in the wards, particularly among female patients ; an attention to this point is to them more important than the application of medicine".[154]

Dietaries For Puerperal Woman

The main foods provided for the women in the City of London and Westminster Lying-In Hospitals, were tea, bread and butter with some gruel. Meat was to be provided on the third and fifth days respectively. The general attitude was that no special diet need be prescribed though if the patient was "delicate" she should be allowed "Wine, Fish, Light Puddings, or any other thing she may fancy".[155] Reference had already been made to the use of a Low Diet after parturition.

Pereira ends his book with a chapter "On the Dietetical Regimen suited for Disordered States of the Digestive Organs". The advice was presented under the headings,

1. Cookery of Foods
2. Times of Eating
3. Quantity of Food taken at one Meal. (This to be determined by the feelings of the patient).
4. Conduct before, at, and after eating.
5. Nature and Quality of the Food eaten.

The subject matter had to be compressed here because the extent of the book was already "considerably greater than was originally contemplated".

The range and detail of *A Treatise on Food and Diet* provided a fresh approach to the subject and made the work an outstanding book of its time. In form and content it is clearly a forerunner of the modern nutrition text book in a way impossible before the work done by physiologists and chemists of the first part of the nineteenth century.

In terms of methods of evaluating foods, the fundamental change between Cullen and Pereira lay in the acceptance of the fact that both

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foodstuffs and the human body were composed of the same sort of *identifiable* chemical elements. This concept (taken with the acceptance of basic chemical laws which are quantifiable and general) led to the ideas on which modern theories of diet are based, that is :

> A food has an intrinsic value related to its chemical composition.
> Different foodstuffs have clearly recognisable different functions.
> Non-living materials, such as minerals, can have nutritive functions.

Also the place of diet in disease had changed. Despite the fact that Pereira couched his advice in the rather vague terms of the patient's appetite and the stimulative or restorative powers of foods, there was also a core of more specific ideas about the relation of food to certain diseases. This can be seen in the recognition that diet might be a factor in the cause of diabetes and that the disease should be treated with specific types of foods. George Budd, in his lectures on "Disorders resulting from defective nutriment" (1842) also referred to three other forms of disease traced to defective nutriment. These were scurvy ; a condition (unnamed) of which "the most distinctive character is a peculiar ulceration of the cornea", and thirdly a disease "chiefly marked by the softness, or imperfect, development of the bones". Budd added a possible fourth disease ; this had diarrhoea as its most striking sympton. It was appreciated that each of these diseases was different and arose as the result of different defects or errors in the diet. At the time it was not possible to pin-point the exact "element" which would prevent the various diseases, but it was recognised that the treatment needed to be dietetic.[156]

Concurrently with these changes in theory there had arisen a practical need for, and greater recognition of, a community responsibility for the dietary standards of various groups, within the population. Changes in the country's administrative structure provided facilities for the application of approved dietary practices and with this came a rapid growth in the information available on applied nutrition.

The continued interest in a wide variety of aspects of the diet of man is exemplified in such frequently quoted books as A. Payen's *Des Substances Alimentaires* (1853), J. Moleschott's *Physologie der Nahrungsmittel* (1859), and later, in England, H. Letheby's *On Food : its varieties, chemical composition, nutritive value, . . . adulteration etc.* (1870), and F. W. Pavy's important *A Treatise on Food and Dietetics* (1874). Also sections on nutrition could be found in a large number of books of the type of C. G. Lehmann (trans. G. E. Day) *Physiological Chemistry* (1851-54) and E. A. Parkes, *A Manual of Practical Hygiene* (1864).[157] From this period nutrition, with dietetics, was developing into a subject in its own right and braking away from its previous old association with medicaments.

The break was helped by the mass of new information in the field of

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materia medica. This made inevitable an abridgement of the information previously included. The change is illustrated by the following works. In the 1837 edition of *Gray's Supplement to the Pharmacopoeia*, Theophilus Redwood included foodstuffs in the animal and vegetable yielding products "employed in Medicine, Domestic Economy and the Arts".[158] In the 1853 edition of Pereira's *Elements*, materia medica was defined as implying "material substances employed in the treatment of disease ; but in a more extended sense, it signifies all remedial agents of whatever kind".[159]

After Pereira's death the editors of the *Elements* (1854-57) said that it had become "a complete Encyclopaedia of Materia Medica" and that its "copiousness had become embarassing". This led to an abridged version edited by Farre in 1865. The work was intended for those with limited time to study, such as "medical practitioners, pharmaceutical chemists, medical and pharmaceutical students". The editors had reduced the work by about two thirds and made far reaching alterations. One of the rules they followed was, "To omit all remedial agents, except those which the author termed pharmacological, such as mental, physical but imponderable, and hygienic remedies, or to be more specific the influence of the mind of light, heat, electricity, food, exercise, climate, etc.".[160]

In the last quarter of the nineteenth century and the beginning of the twentieth, the two main fields of nutritional research were (i) the study of energy metabolism, as in the work of M. Pettenkofer and C. Voit, and Voit's pupil Max Rubner,[161] and (ii) the research on proteins and amino acids by such investigators as T. B. Osborne and R. H. Chittenden.[162] The third edition of R. Hutchison's *Food and the Principles of Dietetics* (1911) described the nutritive value of foods in terms of calories, proteids, fat, carbohydrates and minerals.[163] The work has two chapters on the "Principles of Feeding in Disease" but the concept of diseases due to a specific nutritional deficiency (as opposed to a dietetic error) is not referred to. In 1881, following an animal feeding experiment using an artificial mixture of the individual constituents of milk, N. Lunin had said, "a natural food such as milk must therefore contain besides these known principal ingredients small quantities of unknown substances essential to life".[164] Though this statement contains the essentials of what is believed today, the full significance of these ideas were overlooked until the publication in the *Journal of Physiology* in 1912 of F. G. Hopkin's paper on "accessory food factors".[165] The significance of this paper lay not in its originality, but because the authority of the writer and the place of publication brought the idea of of accessary food factors to the attention of doctors and chemists of the period.

In his paper "A Forty-Year Look at Nutrition Research" (1960), the distinguished nutritionist C. A. Elvehjem pointed out that the science of

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nutrition had not yet been fully recognised by 1920.[166] Between 1920 and 1960 the directions of interest in the field of nutrition have been as widely diverse ; practical applied nutrition among various groups of the population, detailed biochemical research, nutrition education and the place of nutrition in clinical medicine. The greatest emphasis has been on nutrition in the prevention of disease. Writing in *Modern Theories of Diet* (1912) Alexander Bryce started his Preface in this rather optimistic manner,

> "This is the era of preventive medicine. It is no longer a speciality in the hands of the medical officer of health—it has spread into the domain of private practice. There is an increasing tendency to depend less upon drugs and more upon hygienic methods, less upon therapy of any kind, and more upon such attention to the laws of health as will prevent the inception of disease . . . In no branch of this vast subject has greater advance been made than that of dietetics . . ."[167]

However the spread of preventive medicine and the importance of dietetics in medical education did not increase in the way Bryce anticipated. Sinclair points out that Robert Hutchison stated in 1900 in the first edition of his *Food and the Principles of Dietetics*, that it is intended for students and practioners of medicine in view of ' the almost total neglect of the subject of dietetics in ordinary medical education '—a situation (says Sincalir) that has remained unchanged to the present day.[168]

Although today the evaluation of foods is based, primarily, on their nutrient content (which can be ascertained from various collections of food analysis tables) and modern research into metabelism has shown that the action of foods and most materia medica takes place within the same general biochemical framework, this knowledge has not drawn the subjects of pharmacology and nutrition together. The examples given in this paper show that, despite changes in concepts regarding aliments and medicaments, the basic definitions, of nourishing and changing the state of the body, have remained unchanged. It is significant that until recent times leading writers on dietetics were frequently authorities on the materia medica and therefore the two subjects were considered together. Since the middle of the nineteenth century the vast increases in the store of information in nutrition and pharmacology have made specialisation inevitable and the separation of the two subjects has been exaggerated by the marked gap between preventive and clinical medicine in our society. This condition has artificially separated foods and materia medica, two subjects which are clearly complementary to each other in a proper regimen for the preservation of health.

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References and Notes

1. 4 & 5 Eliz. 2, c 16. The first *Sale of Food and Drugs Act* (1875) was consolidated, with a number of amendments, into a single *Food and Drugs Act* in 1938. The main emphasis here is on preparation and hygiene.
2. Cogan's *Haven of Health* was based, with acknowledgements, on the *Regimen Sanitatis Salerni* and Thomas Elyot's *The Castle of Health.* The first edition is used for reference because Cogan had by then translated into English a number of the Latin quotations he had used.
3. The *Treatise of Materia Medica* published in 1798 was based on teaching notes that had been prepared over a period of more than twenty years. See John Thomson, *An Account of the Life, Lectures and Writings of William Cullen M.D.* Edinburgh, 1832, pp. 141-144 and Note Q. pp. 611-618.
4. *Materia Medica,* Vol. I. p. vii. Cullen recognised the value of chemistry in other situations ; see W.P.D. Wightman, "William Cullen and the teaching of chemistry", *Annals of Science,* 1955, *II,* 154—165.
5. The full title is *A Treatise on Food and Diet : with observations on the Dietetical Regimen suited for disordered states of the digestive organs.* After Pereira's death the *Elements* continued under a variety of editors, the last editor being in 1874.
6. H. F. Sinclair and D. F. Hollingsworth have attempted to define aliments and foods more precisely, in relation to the science of nutrition, on p.13 of *Hutchison's Food and the Principles of Nutrition,* twelth edition, London, 1969.
7. Cogan, *Haven of Health* 1589, p. 32.
8. Hippocrates, *Ancient Medicine.* Translated W. H. S. Jones, London 1923, Vol. I. pp. 19—23.
9. J. Stannard, *Bulletin of the History of Medicine,* 1961, 35, 512.
10. Edited by L. S. Goodman and A. Gilman, the quotation is on p. 1649.
11. John Jones, *Galen's Elements,* London 1574, Sig. B 4r. (In cases of books where pagination is absent or unreliable I have used the bibliographical terminology of the letter and number of the ' signature ' as reference.)
12. That the humours represented more than just four body-fluids is shown by the description of the evolution of ideas about the humours given by R. Klibansky, E. Panofsky and F. Saxl in *Saturn and Melancholy* (London, 1964).
13. Gulielmus Gratarolus, (translated by Thomas Newton), *A Direction for the Health of Magistrates and Studentes.* London, 1574, 4th page of the ' Epistle.'
14. Elyot, The *Castle of Health,* London, 1541, Sig. B 1r.
15. Cogan, *Haven of Health,* Sig. gg 4r.
16. L. J. Rather, *Clio Medica,* 1968, 3, 337—347
17. F. J. Furnivall (editor), *The Fyrste Boke of the Introduction of Knowledge made by A. Borde,* London, 1870, p.252. (Early English Text Society, Extra Series No. X) First Edition of Boorde's *A Compendyous Regyment or a Dyetary of Helth,* London 1542.
18. Summaries of Galen's views on foods can be found in F. Adams, *The Seven books of Paulus Aegineta,* London, 1884, Vol. 1.
19. Cogan, *Haven of Health,* p.88.
20. Furnivall, *Introduction of Knowledge,* p. 282.
21. Stannard, *Analecta Medico-Historica,* 1966, 1. 1—21.
22. Alston (published from manuscripts by John Hope), *Lectures on the Materia Medica* London, 1770, vol. I, p.15. Dr. Alston was professor of Botany and Materia Medica in Edinburgh for twenty years until his death in 1760.
23. J. Stannard, *Bulletin of the History of Medicine,* 1969, 3, 214—215.

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24. J. Theodorides and M. D. Grmek "Remarques sur l'Utilisation des Animaux dans la Matière Médicale en XVIe Siècle", *Analecta Medico—Historica*, 1966, 1, 23—27.
25. Cogan, *Heaven of Health*, p. 124.
26. These two works of Galen had been translated into Latin in the sixteenth century ; see R. J. Durling, *Journal of the Warburg and Courtauld Institutes*, 1961, 24, 230—305. The *Pantegni* is included in the works of Isaac Judeaus translated into Latin by Constantinus Africanus, see *Omnia Opera*, Lugduno, 1515.
27. These examples are taken from Buttes, *Dyets Dry Dinner*, Sig. L1^{v}, G 5^{v}, N 7^{v}.
28. Hippocrates, *Regimen II.* Translated by W. H. S. Jones, London, 1931, Vol. IV. p.p 307—343.
29. Furnival, *Introduction of Knowledge*, p. 277.
30. H. Platt, *Sundrie new and Artificial remedies against famine*, London, 1596, Sig. D 1^{r}, says that the smell of bread nourishes the body and refreshes the spirits.
31. John Jones, *The Bathes of Bathes Ayde*, London, 1572, Sig. E 2^{r}—E 4^{r}.
32. Elyot, *Castel of Helth*, Sig. D 2v. Colewort is the general name for plants of the cabbage variety.
33. This view follows Galen. Hippocratic teaching had said that ageing produced a cold moist condition (*Regimen in Health*, trans. W. H. S. Jones, London, 1931, Vol. IV, p. 49).
34. See C. Langton, *An introduction into physicke with a universal dyet*, London, 1550, Sig. F 8^{v} and Elyot, *Castel of Helth*, Sig. D 4^{v}.
35. Langton, *Introduction into physicke*, Sig. H 4^{v} says that concoction in the stomach produced ' juice', other writers sometimes refer to this as ' chile '.
36. *ibid.*, Sig. G 4^{v}
37. *ibid.*, Sig. F 4^{v}.
38. Elyot, *Castel of Helth*, Sig. E 2^{v}.
39. J. Fernal, *De abditis rerum causis*, Sig. 2B 5r. The difference between flesh and stones in relation to nourishment is described in terms of the *vita* and *calore* in living things. (First edition *De abditis*, Paris, 1548). John Jones, *The Benefits of the ancient Bathes of Buckstone*, London, 1572, Sig. B 4v.
40. The term nutrition came into use in the 17th century. The Oxford English Dictionary quotes Helkiah Crooke, *Microsmographia, A description of the body of man*, London, 1615.
41. Cullen, *First Lines of the Practice of Physic*, Edinburgh, 1786, Vol. I. p. xvi (First edition, 1776—1784, does not contain this reference).
42. A. G. Debus. *The English Paracelsians*, London, 1965, pp. 137, 138.
43. J. B. van Helmont (translated by J.C.), *Oriatrike or Physick Refined*, London 1662. Van Helmont's works are here taken from *Ortus Medicinae*, first published posthumously in 1648. See also R. P. Multhauf, *Bulletin of the History of Medicine*, 1955, 29, 154—163.
44. J. Hart, *KAINIKH or the Diet of the Diseased*, p. 30 Here Hart also scoffs at the idea that substances applied to the outside of the body can nourish.
45. *Ibid.*, Book II, pp. 139—213.
46. Van Helmot, *Oriatrike*, pp. 450—421.
47. John Quincy (died 1724 *Pharmacopoeia Officinalis and Extemporanea or a Complete English Dispensatory*, London, 1718, p. 618. Quincy practised medicine as an apothecary in London.
48. William Salmon (1644-1713) described himself as a "Professor of Physic", as far as is known Salmon had no training in either medicine or in science.
49. Quincy, in the Preface to his *Pharmacopoeia Officinalis*, London 1718.

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50. Salmon, *Dispensatory*, London, 1716, p. 238. Quincy, *Pharmacopoeia Officinalis*, pp. 146, 147.
51. Salmon, *Dispensatory*, p. 153 ;
Quincy, *Pharmacopoeia Officinalis*, p. 227
52. Quincy, *Pharmacopoeia Officinalis*, pp. 481—202.
53. Salmon, *Dispensatory*, pp. 174—175 ;
Quincy, *Pharmacopoeia Officinalis*, p. 92.
54. *Traité des Aliments*, (1st. ed. 1702 ; 3rd. ed. Paris 1752) was translated into English anonymously in 1704. D. Hay's (acknowledged) translation as *A Treatise of all Sorts of Food* appeared in three editions in 1745. Reference is here made to the 1745 edition printed by T. Osborne, London. Except for unimportant differences, all versions of the work appear to be similar.
55. Lemery, *Treatise of Foods*, p. 6.
56. *Ibid.*, pp. 94, 95.
57. *Ibid.*, p. 6.
58. *Ibid.*, p. 105.
59. *Ibid.*, p. 6.
60. Lester H. King, *Bulletin of the History of Medicine*, 1969, 43, 28.
61. Cullen, *First Lines*, Vol. I, p. xxx.
62. *Ibid.*, Vol. I, p. xxxii.
63. A von Haller, *First Lines of Physiology*, reprint of the English translation Edinburgh, 1786. *The Sources of Science*, No. 32, New York, 1966. First Latin edition 1744. First English Edition, 1747.
64. T. S. Hall, *Ideas of Life and Matter*, Chicago, 1969, Vol. III
65. Cullen, *Materia Medica*, Vol. I. p. 57.
66. *Ibid.*, Vol. I. p. 59.
67. Referred to by John Thomson, *An Account of the Life, Lectures and Writings of William Cullen, M.D.*, Edinburgh, 1832, p. 393.
68. Cullen, *Materia Medica*, Vol. I, p. 217.
69. *Ibid.*, Vol. II, p. 128, here Corrosives are also described as Caustics, Erodents and Escharotics.
70. *Ibid.*, Vol. I. p. 158.
71. *Ibid.*, Vol. I. p. 217.
72. *Ibid.*, Vol. II. pp. 1, 2.
73. *Ibid.*, Vol. I. p. 240.
74. *Ibid.*, Vol. I. p. 259.
75. *Ibid.*, Vol. I. p. 268.
76. A. A. Parmentier, (1737—1813) did much work on the values of vegetables particularly the potato ; *Examen chimique des pommes de terre*, Paris, 1773.
77. Cullen, *Materia Medica*, Vol. I, p. 289.
78. *Abid.*, Vol. I, p. 293.
79. *Ibid.*, Vol. I, p. 303.
80. *Ibid.*, Vol. I, p. 305.
81. *Ibid.*, Vol. I, pp. 320—323.
82. *Ibid.*, Vol. I, p. xiii.
83. *Ibid.*, Vol. I, pp. 342—346. Cullen also discussed the alimentary and medicinal value of different parts of milk.
84. *Ibid.*, Vol. I, p. 356.
85. *Ibid.*, Vol. I, p. 387.
86. *Ibid.*, Vol. I, p. 396.
87. *Ibid.*, Vol. I, p. 405.

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88. *Ibid.*, Vol. II, p. 153.
89. Cullen, *Institutions of Medicine*, Edinburgh, 1776 (first edition 1772), "For the use of students in the University of Edinburgh" ; see Section IV, "of the Natural Functions" pp. 160—229.
90. *Ibid.*, pp. 185—190.
91. See A. H. T. Robb-Smith, "Unravelling the Function of Blood", *Medical History*, 1962, 6, 1—12.
92. Cullen, *Materia Medica*, Vol. I, p. 224.
93. *Ibid.*, Vol. I, p. 223.
94. *Ibid.*, Vol. I, p. 224.
95. Eliot F. Beach, "Beccari of Bologna, The Discoverer of Vegetable Protein", *Journal of the History of Medicine*, 1961, 16, 345—373.
96. Cullen, *Materia Medica*, Vol. I, p. 224.
97. *Ibid.*, Vol. I, p. 229.
98. *Ibid.*, Vol. I, p. 228.
99. *Ibid.*, Vol. II, pp. 328, 427.
100. See P. J. Macquer (trans. anonymously) *Dictionary of Chemistry*, London, 1777.
101. Cullen, *Materia Medica*, Vol. I, p. 231.
102. *Ibid.*, Vol. I, p. 233.
103. *Ibid.*, Vol. I. p. 58. For theories of the action of medicines up to this time. see M.P. Earles, *Annals of Science*, 1961, 17, 97—110.
104. Cullen, *Materia Medica*, Vol. I, p. vii.
105. F. L. Holmes, *Isis*, 1963, 54, 50—81.
106. C. Brooks, *The Complete English Cook*, London, 1780, p. 115. (First edition 1762)
107. H. Glasse, *The Art of Cookery*, (7th edition 1760), p.p. 233 and 328.
108. W. B. Rabenn, *Essays on History of Nutrition and Dietetics*, Chicago, 1967, p. 193.
109. E. V. McCollum, *A History of Nutrition*, Boston, 1957, p. 134.
110. J. A. Paris (1785—1856) author of *Elements of Medical Chemistry*, London, 1825, also wrote a standard general treatise on materia medica and therapeutics, *Pharmacologia*, 1st ed. 1812 and *Treatise on Diet*, 1st ed. 1827.
111. W. Prout, *Philosophical Transactions*, 1827, Part 2, 355—388. See W. H. Brock, "The Life and Work of William Prout", *Medical History*, 1965, 9, 101—126 and W. S. C. Copeman, "William Prout M.D., F.R.S. Physician and Chemist (1785—1850), *Notes and Records of the Royal Society of London*, 1970, 24, 273—280.
112. J. Liebig, (translated by W. Gregory), *Animal Chemistry, or Organic chemistry in its applications to physiology and pathology*, London, 1842. The first German edition was published in Giessen in the same year.
113. The term carbohydrate was introduced by C. Schmidt in 1844.
114. Charles A. Lee was the editor of the American edition of Pereira's *A Treatise on Food and Diet*, New York, 1843.
115. All editions of Pereira's *Elements of Materia Medica* were published in London. Editors were A. S. Taylor, G. O. Rees, F. J. Farre, R. Bentley, R. Warington and T. Redwood.
116. Pereira, *Elements*, 2nd edition, 1842, p. ix.
117. Ibid., p. 46.
118. Pereira refers to F. Tiedmann's *Untersuchungen über das Nahrungs Bendürfnissden Nahrungs—Trieb and die Nahrungs—Mittel des Menschen*, Darmstadt, 1836.
119. Pereira, *Elements*, (2nd ed.) p. 75.
120. Pereira had described Liebig's ideas in two lectures published in *The Pharmaceutical Journal*, 1842—43, 2, 131—147 and 178—197.

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121. Part 2 of Vol. II of the third edition was edited by Taylor and Rees after the death of Pereira in 1853.
122. Pereira, *A Treatise on Food and Diet*, p. iii.
123. *Ibid.*, p.p. iii, iv.
124. *Ibid.*, p. 5.
125. *Ibid.*, p. 77.
126. The reasons for including alcohol as an alimentary principle are described *Ibid.*, p.p. 50, 51, 52, 54.
127. *Ibid.*, p. 300. Here Pereira gives as an example the fatal effects of smoked sausages being attributed by Buchner to a particular fatty-acid called *botulinic acid* (Wurst-fett-saure).
128. *Ibid.*, p. 437.
129. *Ibid.*, p. 440.
130. *Ibid.*, p. 440.
131. *Ibid.*, pp. 71, 72 footnote. Pereira disagrees with Liebig that "digestion is a process analogous to fermentation".
132. *Ibid.*, pp. 449—451. Taken from W. Beaumont, *Experiments and Observations on the Gastric Juice and the Physiology of Digestion*, Plattsburgh, 1833. The edition quoted by Pereira is that edited by A. Coombe, Edinburgh, 1838.
133. Pereira, *Treatise*, p. 443.
134. *Ibid.*, p. 468. Pereira did not give detailed references to theories of nutrition. Contemporary ideas of this are given in W. B. Carpenter's article on "Nutrition" in R. B. Todd (editor), *The Cyclopeadia of Anatomy and Physiology*, London, 1839—47, Vol. III, p. 741—758.
135. Pereira, *Treatise*, p. 468.
136. *Ibid.*, p. 55 quotes J. B. Boussingault (1802—1887).
137. *Ibid.*, p. 469. Following the work of H. G. Magnus, of 1837, in which he showed more oxygen in arterial than venous blood, many people, including Liebig, accepted that ' combustion ' took place in the tissues rather than the lungs.
138. *Ibid.*, p. 462.
139. *Ibid.*, p. 472. This was the traditional view.
140. *Ibid.*, pp. 474—478. See also *Réglement sur le Régime Alimentaire des Hôpitaux et Hospices civils de la Ville Paris*, Paris 1841, a report approved by the Minister of the Interior.
141. Pereria, *Treatise*, pp. 483—490. Details of all six of the Poor Law diets are given.
142. *Ibid.*, p. 491.
143. *Ibid.*, p. 497.
144. *Ibid.*, pp. 506—509. Hospitals included are : The London ,St. Bartholomew's, Guy's, St. Thomas's, St. George's, Westminster, Middlesex, King's College, North London, Dreadnought Hospital, Ship and Royal Naval and Royal Ordinance Hospital.
145. J. Rollo (d. 1809), *The Cases of Diabetes Mellitus*, Deptford, 1797.
146. George Budd, (1808—1882) *The London Medical Gazette*, 1842, N.S.2, 169.
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148. W. Lambe (1765—1847) *Reports of the Effects of a Peculiar Regimen on Scirrhous Tumours and Cancerous Ulcers*, London, 1809 ; *Addition Reports*, London 1815.
149. Pereira, *Treatise*, p. 281.
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152. Pereira, *Treatise*, p. 505.
153. Ibid., p. 510, quoted W. B. Carpenter (1813—1855), *Principles of Human Physiology*, London, 1842, p. 384.

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